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AUTHOR Clegg, Ambrose A., Jr.; Sebolt, Alberta P.
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ABSTRACT

The purpose of this study was to develop evaluation procedures and to test the evidence of concept learning at various cognitive levels in an experimental social studies curriculum. A number of social science concepts relating to the use of natural resources were identified for use with Curriculum Model #1 on the Quabbin Reservoir system. A preliminary form of a concept development test was prepared, using the general approach developed by Kropp and Stoker (1966). This approach was appropriate because curriculum objectives had been identified according to Bloom's taxonomy, and major concepts had been identified and structured. The problem questions were designed to test student performance on analysis, sythesis, and evaluation, in realistic problem situations related to the curriculum. Students (120) from four of the experimental classes, grades 3, 4 and 5, were tested. In conclusion, the concepts were acquired at a rather high rate of success with mean scores for the group ranging from 65-76% concept achievement; the differences between grade levels were small; and, the difference in achievement between the experimental and control groups was significant (p.<0.001). All of these results seem to validate the effectiveness of the curriculum design and the teaching strategies (see SO 000 068). Other related documents are SO 000 069 and SO 000 070. (SBE)

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Ambrose A. Clegg, Jr.
University of Washington

Alberta P. Sebolt
Resource Learning Laboratory
Sturbridge, Massachusetts

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ABSTRACT

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Ambrose A. Clegg, Jr.
University of Washington

Alberta P. Sebolt
Resource Learning Laboratory

The purpose of this study was to develop procedures for and to test the evidence of concept learning at various cognitive levels in an experimental curriculum in social studies. The instructional material involved the study of seven concepts related to the topic of water resources with behavioral objectives specified at each of the levels of Bloom's cognitive taxonomy. The curriculum design centered about the use of local field resources, Taba's strategies of teaching, and inquiry-oriented instructional materials.

The Ss in the experimental program were 120 students in grades 3, 4, and 5 in a middle-class and an inner-city school in central Massachusetts. Ninety students in three comparable classes served as control measures for the development of the concept test. Because this study was a pilot study incorporated into the planning stage of a Title III project a quasi-experimental design was used.

An analysis of variance on the mean scores of the test of concept achievement revealed significant differences ($p. < .001$) between the control and experimental groups. Significant F ratios were obtained for each of the main parts of the test, as well as for the subscores when items were grouped by concept taught, and by their cognitive level according to the Bloom Taxonomy. When possible initial differences that might be due to Reading, Achievement, or IQ were held constant by the use of analysis of covariance technique, differences between the experimental and control were still significant at the $p. < 001$ level.

Analysis of the data also indicated a high rate of achievement for each of the concepts with comparatively small differences in mean scores between grade levels. When test items were classified by cognitive level mean scores ranged from 69-72% correct on items in the knowledge, comprehension, application and analysis categories, but only 43% at the evaluation level. Synthesis items proved unsatisfactory and had to be discarded from the analysis of the data.

The high level of concept achievement at a wide variety of cognitive levels appeared to validate the effectiveness of the curriculum design and the teaching strategies employed. The use of the local field resources as a learning laboratory, together with inquiry-oriented instructional materials, seems to have had an effect upon reducing the usual differences to be expected across grade levels by providing opportunities for learning that were not limited to the traditional school materials. The data also suggests that young children can acquire and use sophisticated concepts in geography by using readily available local field resources as a basis for gathering concrete observations about complex phenomena.

This paper is a preliminary report of a study on Concept learning conducted by Resource Learning Laboratory, under the direction of Alberta P. Sebolt. RLL has been funded by the USOE under ESEA-Title III

INTRODUCTION

One of the problems confronting any innovative curriculum project is the lack of adequate instruments for testing and evaluation. This paper is a report of the evaluation procedures developed for use by the Resource Learning Laboratory to assess the extent of concept learning with the use of experimental, inquiry-oriented curriculum materials.

The Resource Learning Laboratory (RLL) was established as a part of a Title III planning grant awarded to School Union #61, Sturbridge, Massachusetts for 1968-69. The project is currently funded as an operational grant for 1969-70. The chief purpose of RLL is to plan and develop curriculum materials that demonstrate the use of locally available community resources as learning laboratories. Curriculum materials are focused upon important concepts from the social science disciplines using an inquiry-oriented approach to learning.

Curriculum models developed for each learning laboratory are referred to as RLL Model #1, #2, etc. These models are mini-systems which comprise a modification of the elements described by Tyler (1949):

1. purpose or objectives
2. learning experiences
3. organization of content
4. teaching strategies
5. evaluation of the experience

Educational Objectives

The educational objectives of the RLL Model #1 and successive models are concerned with the basic human activities of man as listed by Hanna (1956).

The objectives of each model are expressed at two levels of specificity. The first level or general objective serves to direct the scope of the model. This objective is implicit in the problem to be solved i.e....How does man secure and conserve water? Concepts to be developed within this level are identified and classified by high order and low order, a hierarchy defined. The content is therefore dictated by the nature of the concept or concepts.

The second level is the instructional objective which states in behavioral terms the desired performance of the student. The instructional objectives are related to a psychology of learning in that they identify the sequence and conditions of behavior necessary for (a) concept formation, (b) interpretation of data and formulation of generalizations and (c) application of principles.

It may be noted that level one deals with the educational purposes while level two provides the skeleton upon which the learning experiences may be developed.

Organization of Learning Experiences

The learning experiences were designed through analysis and inventory of the learning tasks necessary for attainment of the formulated objectives. The learning tasks were stated in behavioral terms as described by Mager (1962), noting that the behavior was both observable and measureable. That is, the task was clearly defined by telling what the learner is doing, under what conditions, using what materials, and to what degree of competence. Though elements 2 and 3 of the model appear separately, they were in fact developed simultaneously. The learning experience and the organization of the experiences are implicit in the behavioral objective.

The learning experiences were identified in accordance with the role they were to play within the model i.e....pre-field, field, or post field. They were designed to provide a variety of experiences involving multi-media (primary source material - documents, ledgers, maps, vital statistic records, photos, newspaper articles, simulated primary source material, films, slides, transparencies etc.).

Primary source materials provided the vehicle for inquiry. Through inquiry, these materials provided the student with the data necessary to make inferences and verify his hypothesis. Where adequate data was not evident within the primary source materials the student then utilized the field-lab. In some cases the field-labs served to contrast and compare data or to verify predictions. Cameras were also utilized to film data for later verification. Newspaper articles provided the student with a sense of fervor of the

times relative to the issue in question. Maps served both as a tool for skill development and for making inferences in the process of comparing and contrasting changes in the growth patterns of a community. Vital statistic records provided insight as to the place of origin, occupation etc. of the people within the community.

The materials listed and described, while providing the vehicle for inquiry, in no way insure that the student will engage in this process. It is rather the strategies which the teacher employs in the use of the material.

Teaching Strategies For Inquiry

The teaching strategies within the RLL Model are based on a cognitively oriented learning theory. Recent research in science and math stimulated similar studies in the Social Sciences which have demonstrated the importance of conceptualization and generalization as essential cognitive abilities. Probably the most fundamental work on conceptualization as a theory and process has been done by Jerome Bruner (1966) and Hilda Taba (1966). Both Bruner's and Taba's studies of children's learning show evidence of influence of Piaget's suggestion of progressive sequence in the development of cognitive skills (Inhelder, 1962). These learning theories postulate that the child does not inevitable move from a lower to a higher phase of cognitive development but rather that there is a progressive sequence. The Taba inquiry strategy was chosen as it clearly identified both the type of teacher question and kind of student activity necessary to achieve each cognitive task. The Strategy is clear cut and has proved a successful vehicle for the development of cognitive skills. Initial piloting of the modified Taba (1967) strategies indicates the questions are specific enough to aid the teacher in each of the cognitive tasks.

The questioning process in the Taba strategy, while teacher-directed, is not to be misinterpreted as highly directed teacher behaviors. The strategies provide for highly-integrative behaviors purposefully designed to provide systematic guidance in conceptualizations, interpretation, generalization and application of principles.

The Taba strategies, as modified within the RLL model, are based on the theory that learning is a continuous process requiring both the assimiliation of the new data and the accommodation of previous conceptual systems to the criteria of the new.

Evaluation

Evaluation of the model is in both the form of a feedback system and a test for concept development. The feedback system implies that the criterion measures used in the evaluation will supply data indicating the extent to which each objective is being attained both by the individual student and the class as a whole. When objectives are written in behavioral terms the task of evaluation is made much simpler since the intended learning outcomes have already been

specified in advance. Failure to accomplish the objectives at specified levels then suggests clues for the planning of alternative learning experiences, thus revision of each of the component parts... pupil entry behavior, teaching strategies, and pupil learning processes, and the selection and organization of content materials appropriate to the objectives. Teacher participants and classroom observers provided the feedback data for evaluation of output and revision prior to the second piloting period.

The Concept Test:

A number of social science concepts relating to the use of natural resources had been identified for use with the first curriculum model on the Quabbin Reservoir system (Sebolt et. al., 1968). These concepts were:

1. Watershed
2. Landforms
3. River system
4. Population pattern
5. Technology
6. Supply and demand

Since the behavioral objectives for the model were identified according to the categories of Bloom's (1956) Taxonomy: Cognitive Domain, a number of specific test items could be developed that tested for acquisition and ability to use the concepts at a variety of different and higher cognitive levels.

Test Instrument:

A preliminary form of a test of concept development was prepared, using the general approach developed by Kropp and Stoker (1966) in their study of the construction and validation of tests of cognitive processes. This approach was particularly appropriate since the curriculum models prepared has already identified their objectives according to the cognitive levels of Bloom's Taxonomy, and had also identified the major and related concepts into hierarchies of complexity. Forty multiple choice and matching items, plus seven problem-type questions were used on Form A of the Test of Concept Learning. Each of the items was keyed to a particular level of the taxonomy. The problem questions were designed to test out students' performance on the higher levels of analysis, synthesis, and evaluation, in realistic problem situations related to the study. Sample test items and problems are given in Appendix A.

Sample Population:

The first of the curriculum models, the Quabbin Reservoir study, was pilot tested in four experimental classes, grades 3, 4, and 5 during February and March, 1969, and the test of concept learning was administered to 120 students in these classes in March, 1969. The Ss in grade 3 and in two sections of grade 4 were all from one school in a middle-class community in central Massachusetts. The

Ss in grade 5 were from an inner-city school in a large urban area in western Massachusetts. Many of these latter students were from black or Spanish-speaking ethnic minority groups.

Since the test had been newly designed and no normative data was available, the same test was administered to a comparable control group (N=120) to test out the effect of general knowledge on pupil scores.

Testing Procedures:

The test was administered by members of the RLL staff to each of the experimental classes. A standard set of directions had been prepared and was read to each group. The test was not a time test; and there was a short recess break between the short answer and problem sections.

Analysis of the Data:

Data from the test was organized in three ways: (1) by class means for total test scores as well as for each of the sub-test scores (Table I); (2) composite achievement (percent correct) by concept studied (Table II); and (3) composite achievement (percent correct) by taxonomy level (Table III). An item analysis was also made for each item on the test and will be used in subsequent revisions of the test. An analysis of variance was used to determine the statistical signficance of differences between experimental and control groups on the total scores and each of the sub-test scores (Tables IV, V, and VI). An analysis of covariance was used to statistically hold constant any initial differences between groups that might be due to external factors such as reading, achievement, and I.Q. (Table VII).

FINDINGS

Main Parts of the Test:

A summary of the mean scores of the experimental and control groups on the main parts of the RLL test of concept learning is presented in Table I. These mean scores were then analyzed by an analysis of variance technique. As shown in Table IV there were significant differences between the two groups for the total test ($p. < .001$) as well as for all other parts of the test.

Part I of the test was a multiple choice response dealing with the attainment of the various concepts. Items in this part of the test ranged from the knowledge through the analysis level. The difference between experimental and control groups was significant at the .001 level.

Twelve of the test items dealt with specialized vocabulary related to the curriculum unit and as might be expected the results

were significant at the .001 level. On the hunch that the vocabulary subscore might have had a disproportionate influence on the total score we examined the difference in total scores when the vocabulary subscore was removed (Total Less Vocab) and again the differences were significant ($p. < .01$).

Part II consisted of a series of six problem type items written at the application, analysis, synthesis and evaluation levels. Differences between the experimental and control groups were significant ($p. < .05$).

An item analysis for Part II indicated that many of the items were quite difficult, with difficulty indices of .3 and .4 and similarly low discrimination indices. (And in some cases, even a few negative discrimination indices!) Test items originally prepared at the synthesis level were judged unsatisfactory based on the item analysis and were omitted from the analysis of the data reported here (see Tables III and VI). Many of these weaknesses have since been taken into account in the revision of the test which has recently been given to a new group of experimental and control groups.

Subscores Grouped by Concepts Taught:

An analysis of variance was made on the subscores for the test items when grouped by the concepts taught (Table V). Significant differences (p. either $< .01$ or $< .05$) were found between the two groups for six out of seven concepts. Only the concept "technology" was non-significant, although the F ratio approached significance at the .05 level.

Subscores Grouped by Taxonomy Level:

When the test items were regrouped according to the cognitive level of Bloom's Taxonomy (Table VI) significant differences favoring the experimental group were found at the knowledge ($p. < .01$), comprehension ($p. < .05$), application ($p. < .05$), and analysis ($p. < .01$) levels. The evaluation items produced non-significant differences. As indicated earlier, the synthesis items proved unsatisfactory and were discarded prior to the analysis of the data.

External Influences: Reading, Achievement, and IQ:

Since RLL is concerned with the evaluation of a new curriculum program, the experimental model was tried out in a naturalistic classroom setting. In-tact groups, rather than randomly assigned individual subjects, were the units of measure. Accordingly, the analysis of covariance (ANCOVA) was used to control for possible initial differences that might be due to such external factors as reading, achievement, or IQ scores. As indicated in Table VII, the two independent variables, Total Score, and Total Less Vocabulary, were covaried separately, with the standardized test scores for reading, achievement, and IQ having been obtained from the student's current school records.

In every case significant differences (p. $<$ .001) were found. Even when the three covariates were taken in combination, the differences between groups were significant at the same .001 level. It appeared evident, then, that the differences between the groups were not due to the possible initial differences on any or all of the three covariates.

Achievement by Concepts:

Achievement of each of the six concepts is reported in Table II as percent correct when items were regrouped by concept. Group means ranged from 65% - 76% correct, with several classes achieving as high as 86% on particular concepts. It is interesting to note that the two concepts that appear most abstract, watershed and supply and demand, had the highest mean rate of achievement (76% each), while the concept landform, which was probably the most concrete and which was the main focus of an extensive field trip, had the lowest mean achievement (65%). The scores for the 5th grade inner city group are quite close to the group means on three concepts, landforms, population patterns, and river systems, though widely separated on the remaining three concepts.

Achievement by Cognitive Level:

Student achievement at higher cognitive levels is reported on Table III as percent correct when test items were regrouped by taxonomic level. The composite mean scores for all groups were Knowledge, 72%; Comprehension, 69%; Application, 72%; and Analysis, 70%. The two fourth grade classes had mean scores as high as 80-81% on application and 82% on knowledge for one class. The fifth grade inner city school mean score was close to the group means on the comprehension items, but ranged for 11-13 points below the group means on knowledge, application, and analysis items.

The mean score for the evaluation items was only 43%, a marked difference from the higher scores of the other levels. Very curiously, the third grade class had the highest mean score (57%) on synthesis items, a difference of 14 points from the group mean, and as much as 24 points from one of the fourth grade classes. The fifth grade class had a mean percentage of 39% correct, only 4 points different from the group mean.

Test items were originally prepared at the synthesis level but these proved unsatisfactory at all grade levels and were discarded after the initial scoring. In the judgement of the REL staff, there was apparently too little instructional material prepared at the synthesis level. It may also be that the teaching strategies which were employed (Taba's three cognitive tasks of concept formation, generalization, and application of principles) did not include enough synthesizing activities that approximated those included in the synthesis level of Bloom's Taxonomy.

In the absence of any comparable normative data, the mean hievement scores reported for the knowledge, comprehension, plication, and analysis levels (averaging 70.75%) appear to present rather high levels of accomplishment, particularly for e first try-out of pilot materials.

No obvious explanation readily accounts for the relatively low rformance of the total group on the evaluation level or the latively high performance by the third grade class on this factor. ta from the item analysis indicate that the problem questions volved were of moderate difficulty (mean difficulty index of .58) though a wide difference in the discrimination indices (varying om - .250 to .715) suggests that the test questions may have been sleading to students in the upper and lowere 27% groups. It is at ast safe to conclude that there probably were not enough evaluation pe activities included in the instructional materials for adequate aining in this skill to have been accomplished.

CONCLUSIONS

As indicated above, the task of a curriculum evaluation is to k, "How well did the curriculum succeed in meeting its own goals?" sed upon the data presented in this study, the concepts appear to ve been acquired at a rather high rate of success. While there s much individual variability, mean scores for an entire group nging from 65-76% achievement over the six concepts appears very tisfactory for a pilot project. As teachers become more familiar th the instructional materials, and more skilled with the use of e teaching strategies, one might expect these scores to increase about 80% achievement.

Similarly, the wide range of cognitive objectives appears to ve been accomplished to a high degree. This suggests that the aching strategies employed, or perhaps the way in which the terials were structured, did involve a range of higher level tellectual skills (knowledge, comprehension, application, and alysis) and that each was accomplished at a rather uniformly high te. Such data appears to offer additional evidence in support of nkins' (1968) earlier finding that student's achievement is increased significantly when instructional materials are structured include activities at higher cognitive levels.

The apparent lack of differences in scores over grade levels ises questions about two important factors: (1) the presumed fficulty of the material and its sequence in the curriculum (i.e., rade level placement); and (2) the relation of reading ability as critical variable in the design of curriculum models.

Recognizing the limits of this brief study, it appeared that ildren at several different age and grade levels could handle this terial easily, and that its content was not dependent upon prior hool learnings. One might conclude that the Quabbin Reservoir tudy is designed so that it can be used easily at a number of

different grade levels and with different student populations, making it a flexible and easily adopted unit of study.

Although other studies (Hunkins, 1968, 1969a, 1969b) have found that reading ability is significantly related to achievement at higher cognitive levels, the preliminary data reported here leads one to conclude that in this particular curriculum design, vocabulary and perhaps reading skills in general, may not have had as critical an influence upon student outcomes as might have originally been expected. An important feature of the curriculum model was a carefully designed field trip to the Quabbin Reservoir and its surrounding area. Subsequent activities related closely to this trip and the area visited. In short, the local resource is used as a learning laboratory, but in a largely non-verbal way. This may account, in part, for the apparent lack of differences over grade levels, since grade level norms are so largely a product of reading ability.

Lastly, the curriculum model appears to have been quite successful with the fifth grade children from the inner city school. As indicated in Tables II and III, the difference in mean IQs between the inner city group and the predominantly white, middle class children in the third and fourth grades is more than two standard deviations from the assumed mean of 100. Yet the mean scores for the fifth grade class are not too distant from the composite means of the entire group, or the third and fourth graders considered alone. If, as suggested above, reading ability does not have as critical an influence as might have otherwise been expected, the curriculum model developed by RLL (Sebolt, et. al., 1968) and incorporated into the Quabbin Reservoir study, appears to have considerable usefulness for schools in inner city areas. In any event, the outcomes in student learnings for this sub-group, while not as high as for the remainder of the experimental group, are more than sufficient to be considered successful -- particularly for the first tryout of a pilot model. And that, in itself, is encouraging!

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TABLE I

MEAN SCORES OF EXPERIMENTAL AND CONTROL GROUPS ON RLL TEST OF CONCEPT LEARNING

QUABBIN RESERVOIR STUDY - FORM A

	GRADE	SCH	TR	N	MEAN SCORES Part I	Part II	Vocab.	Total	Total less Vocab
Experimental	3E	B	J	31	26.39	5.32	8.00	39.71	31.71
	4E	B	C	31	28.26	5.96	7.58	41.80	34.23
	4E	B	E	29	29.00	5.66	8.31	42.97	34.65
	5E	D	G	27	25.04	4.15	6.74	35.92	29.52
	Composite Means				27.17	5.27	7.66	40.10	32.53
Control	3C	B	S	29	18.45	3.07	1.69	23.21	21.51
	4C	B	V	27	19.33	3.77	4.00	26.96	23.11
	5C	D	W	24	16.58	3.39	2.69	22.26	19.91
	Composite Means				18.12	3.39	2.69	24.14	21.51

TABLE II

COMPOSITE PERCENT CORRECT BY CONCEPT FOR EXPERIMENTAL GROUPS
RLL TEST

Quabbin Resevoir Study - Form A

GR	SCH	TR	N	$\bar{X}$ IQ	Watershed	Supply and Demand	River System	Technology	Population Patterns	Landforms
3	B	J	31	114.45	.76	.71	.70	.73	.68	.59
4	B	C	31	112.28	.75	.86	.69	.78	.80	.66
4	B	E	29	113.36	.84	.82	.86	.81	.63	.71
5	D	G	27	89.90	.68	.66	.70	.59	.67	.65
				MEANS	.76	.76	.74	.74	.70	.65

TABLE III

COMPOSITE PERCENT CORRECT BY TAXONOMY LEVEL FOR EXPERIMENTAL GROUPS
RLL Concept Test

Quabbin Reservoir Study - Form A

GR	SCH	TR	N	$\bar{X}$ IQ	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
3	B	J	31	114.45	.72	.65	.66	.72	*	.57
4	B	C	31	112.28	.73	.71	.81	.74	*	.42
4	B	E	29	113.36	.82	.75	.80	.74	*	.33
5	D	G	27	89.90	.61	.66	.59	.59	*	.39
				MEANS	.72	.69	.72	.70	*	.43

*Test items originally prepared at the synthesis level proved unsatisfactory and were discarded prior to analysis of the data.

TABLE IV

ANOVA of MAIN PARTS of RLL TEST of CONCEPT LEARNING

Dep. Var.	Source	SS	df	MS	F	p
PART I	Between	140.481	1	140.481	51.545	<.001
	Within	13.626	5	2.725		
VOCAB	Between	42.358	1	42.358	50.315	<.001
	Within	4.209	5	.841		
PART 2	Between	6.075	1	6.075	14.224	<. 05
	Within	2.135	5	.427		
TOTAL	Between	4[illegible].665	1	436.665	53.069	<.001
	Within	41.140	5	8.228		
TOTAL LESS VOCAB	Between	208.089	1	208.089	46.789	< 01
	Within	22.236	5	4.447		

TABLE V

ANOVA of Subscores on ALL Test Items Grouped by Concepts Taught

Dep. Var.	Source	SS	df	MS	F	p
Water System	Between	9.840	1	9.840	41.683	<.01
	Within	1.180	5	.236		
Land Forms	Between	2.779	1	2.779	14.717	<.05
River	Between	3.344	1	3.344	39.390	<.01
	Within	.424	5	.084		
Water Source	Between	7.979	1	7.979	20.237	<.01
	Within	1.971	5	.394		
Population Patterns	Between	3.174	1	3.1746	25.350	<.01
	Within	.626	5	.1252		
Technology	Between	1.248	1	1.248	5.864	NS (<.10)
	Within	1.064	5	.212		
Supply and Demand	Between	2.964	1	2.964	11.214	<.05
	Within	1.321	5	.264		

TABLE VI

ANOVA of Subscores on ALL Test Items Group by Levels of Bloom's Taxonomy

Dep. Var.	Source	SS	df	MS	F	p
Knowledge	Between	15.764	1	15.764	26.427	<.01
	Within	2.98[illegible]	5	.596		
Comprehension						
	Between	4.7002	1	4.7002	9.786	<.05
	Within	2.4015	5	.4803		
Application	Between	.678	1	.678	8.102	<.05
	Within	.418	5	.083		
Analysis	Between	31.025	1	31.025	33.830	<.01
	Within	4.585	5	.917		
Synthesis*	--	--	--	--	--	--
Evaluation	Between	.174	1	.174	6.293	NS (p<.10)
	Within	.138	5	.027		

*Test items originally prepared at the synthesis level proved unsatisfactory and were discarded prior to the analysis of the data.

TABLE VII

ANCOVA OF MAIN PARTS OF RLL CONCEPT TEST USING LEADING, ACHIEVEMENTW AND IQ AS COVARIATES

Dep. Var.	Covariate	Source	Residiual SS	df	MS	F	p
TOTAL	READ	Treatment	286.344	1	286.544	953.963	<.001
		Error	1.201	4	.300		
TOT LESS VOC	READ	Treatment	134.362	1	134.882	353.855	<.001
		Error	1.524	4	.381		
TOTAL	ACHMT	Treatment	322.6717	1	322.671	1226.073	<.001
		Error	1.052	4	.263		
TOT LESS VOC	ACHMT	Treatment	152.069	1	152.069	543.204	<.001
		Error	1.119	4	.279		
TOTAL	IQ	Treatment	348.351	1	348.351	81.869	<.001
		Error	17.019	4	4.255		
TOT LESS VOC	IQ	Treatment	153.615	1	153.615	77.948	<.001
		Error	8.396	4	2.099		
TOTAL	READ, ACHMT, and IQ	Treatment	113.642	1	113.642	1718.518	<.001
		Error	.132	2	.066		
TOT LESS VOC	READ, ACHMT, and IQ	Treatment	61.735	1	61.735	126.695	<.001
		Error	.974	2	.487		

Appendix A

Sample Questions Taken from the RLL Concept Test

10. A tributary is: (Concept: River)

_____ a stream flowing south
_____ a stream which feeds a larger stream
_____ a river system in Massachusetts
_____ a stream which has pure water

24. Using the contour map, the land elevation at Quabbin Resevoir is:

_____ below sea level (Concetp: Landforms)
_____ the same as Boston
_____ lower than Boston
_____ higher than Boston

Problem 4: A large city in our state needs to find an additional source of water supply. A committee that investigated the possible sites reported the following information. Based on this information, where would you place the resevoir?

	SITE A	SITE B	SITE C
Kind of water	pure	pure	needs filtering
Amount of Water	good supply	good supply	good supply
Number of people in the area	few	few	heavily populated
Number of industries	few	few	many industries
Distance from city	50 miles out of state	70 miles in state	20 miles in state

The best site for the resevoir would be:

_____ Site A
_____ Site B
_____ Site C